Section D

Hydrology and Water Quality

HYDROLOGY

Setting

Surface Water

The project site is located near the southeastern margin of the Sacramento-San Joaquin Delta. The site is bounded by the San Joaquin River on the southwest, the Calaveras River on the southeast, Ten Mile Slough on the west, and Fourteen Mile Slough on the north. The levels of bordering waters fluctuate in response to marine tidal changes. The only substantial flow of water occurs in the San Joaquin River (Stockton Deep Water Channel) and the Calaveras River. Like most rivers in the Central Valley, the San Joaquin and its tributaries receive most of their supply from precipitation in the Sierra Nevada.

The San Joaquin River drains 13,536 square miles (sq mi) and has an average discharge (over 56 years of record) of 4,788 cubic feet per second (cfs). Its maximum discharge, on December 9, 1950, was 79,000 cfs, and its minimum was 19 cfs on August 10, 1961 (U. S. Geologic Survey 1984).

The Calaveras River drains an area of 609 sq mi. It can generate peak 10-year discharges of 12,500 cfs, but on many days throughout the year there is no flow in the Calaveras near Stockton because its entire flow is diverted upstream. The water of the Calaveras River is diverted into Mormon Slough, from which it is withdrawn for irrigation and domestic consumption. Unused water returns to the Calaveras channel via the Stockton diverting canal. In the event of a 100-year flood, water can be channeled directly into the Calaveras, rather than flowing into Mormon slough.

Fourteen Mile Slough has little flow; its water level mainly reflects tidal effects.

Internal drainage of the site is designed for agricultural operations. The system of drainage channels flows to a pump at Fourteen Mile Slough.

Reclamation Districts and Levees

Agency Jurisdiction. The entire project site is protected from flooding hazards by levees. The property is in Reclamation District 2074, which was formed in 1927. The Ten Mile, Fourteen Mile, Buckley Cove, and Smith levees are the responsibility of Reclamation District (RD) 2074, which has prepared a plan of reclamation calling for the reconstruction of Buckley Cove, Ten Mile, and Fourteen Mile levees to higher elevations. This plan

was prepared in response to risks posed by the poor condition of the levees on the Wright-Elmwood Tract immediately to the west of the Brookside site. An EIR has been prepared for this proposal (R. C. Fuller Associates 1983). The Smith levee on the east side of the property now serves no useful function and is not maintained.

Other agencies are responsible for levees on the Stockton and Calaveras Rivers. The Stockton Channel levee is maintained jointly by the COE, the Port of Stockton, and RD 2074. The Calaveras River levee is under the control of the San Joaquin County Flood Control and Water Conservation District (Yost pers. comm.). The Calaveras River levee is under the jurisdiction of the California Reclamation Board, and any encroachments would require a permit from the Board (Barsch pers. comm.).

Some of the levee reconstruction has already taken place. COE work during the 1970s to increase levels of protection was halted in 1977 when the City of Stockton removed the "urban reserve" designation from the project site, leaving the work to be completed by RD 2074 (R. C. Fuller Associates 1983). In 1983-84, engineered fill from the center of the project site was used to raise Ten Mile levee to 100-year flood elevations. This excavation created the borrow pit. In fall 1987, R. D. 2074 began using dredge spoils from Fourteen Mile Slough to increase the elevation of Fourteen Mile levee. Additional fill from within the site would be needed to raise Fourteen Mile levee to 100-year design elevations. Much of the fill material to be excavated from the site would contain peat. Peat is not a suitable material for levee construction because it is subject to oxidation and deflation. However, when mixed with more stable materials, the excavate from the interior of the project site could be used for levee construction. All recent plans and construction by Reclamation District 2074 have been done using studies, recommendations, and field review of a soils engineer (Yost pers. comm.).

Levee Stability

Levee stability and resistance to wave action can be problems in the Delta, but could be controlled on the project site by careful engineering and construction. The following analysis has been conducted by R. W. Siegfried & Associates (Yost pers. comm.). Seepage and wind have caused little erosion. Seepage, which can be a problem during persistent winter high water, is monitored and dealt with immediately to prevent damage to levees.

Wind-generated waves can be a problem on Ten Mile Slough levee. It is a dryland levee that was designed to control flooding and additional wave run-up if the Wright-Elmwood Tracts flood due to a levee break during high water conditions and strong and persistent northerly winds. The coincidence of factors inherent in all three conditions constitute a rare event. The all-weather maintenance road atop Ten Mile Slough levee and the limited hazard suggest that additional wave protection is not necessary. No wave hazard affects the other project levees.

Levee erosion caused by flow velocities is not considered a problem on Ten Mile or Fourteen Mile Levees. Fourteen Mile levee carries very little flow, and water movement primarily reflects tidal fluctuations. Ten Mile

Slough levee serves as protection against flooding of adjacent tracts, and therefore carries no flow. The flow volume of the San Joaquin River is such that flow velocities are not considered serious erosion hazards. The Calaveras River, however, can cause flow-generated scour along its levee. The Calaveras levee is maintained by the San Joaquin County Flood Control District.

Some levee erosion is caused by wave action from passing boats. Stone riprap is the usual protection for wake erosion, and the project proponent intends to face portions of the Fourteen Mile levee that are vulnerable to boat wake erosion.

Flooding

The project site lies within the 100-year flood zone as designated by FEMA (Figure D-1). New flood hazard maps will be published in mid-1988. These maps are not expected to vary from the 1987 draft flood hazard maps upon which this report is based. The COE estimates that a 100-year flood would inundate the project site property to a depth of 7.4 feet, National Geodetic Vertical Datum (Yep pers. comm). The Fourteen Mile levee was overtopped during winter 1982-83. This flooding risk must be controlled if the proposed project is to proceed.

According to FEMA, levee heights must exceed 100-year flood elevations by at least 3 feet. For Fourteen Mile levee, this height would be 11.1 feet, whereas the present crown of the levee is about 9 feet (R. C. Fuller Associates 1983).

The crown heights of the Calaveras and Deep Water Channel levees are considered acceptable (Wilkinson pers. comm.). Ten Mile and Buckley Cove levees now meet 100-year flood standards.

The high groundwater levels of the project site require careful management to permit successful agricultural production. The site is well served by drainage ditches to lower groundwater levels. One Reclamation District 2074 drainage pump serves the project site, and it drains into Fourteen Mile Slough.

Project Impacts and Mitigation Measures

Impact: Location of the Project in an Area Subject to Flooding

The development of urban uses on the project site without further levee improvements constitutes a significant impact due to the potential for damage in the event of flooding.

Mitigation Measures

- Increase the height of Fourteen Mile levee to 11.1 feet, the design height required to protect the Brookside property against 100-year floods.

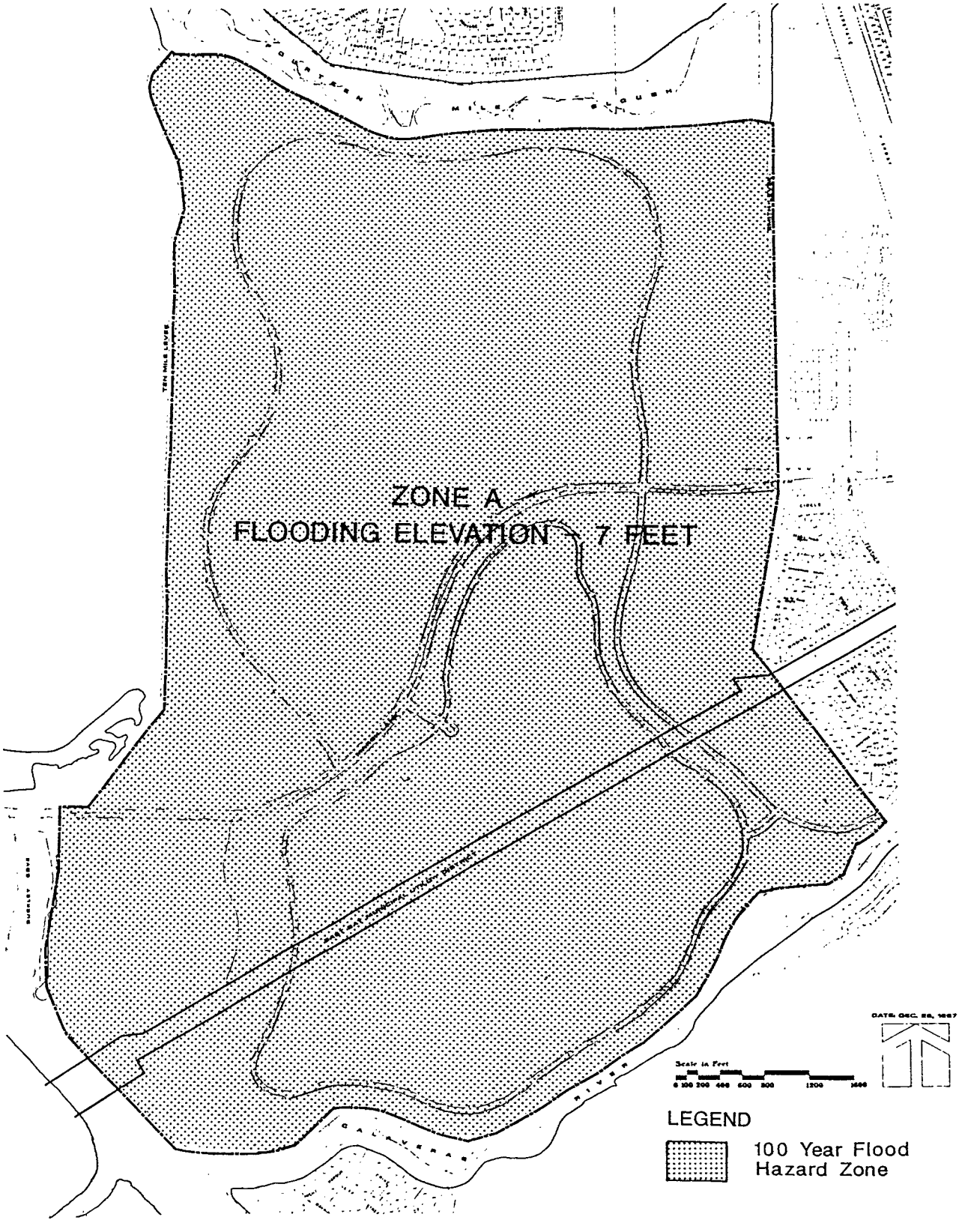

FIGURE D-1. FLOOD HAZARD LEVELS

Source: Federal Emergency Management Association, 1980

C-065255

- o Implement flood protection requirements of FEMA and the COE.
- o Monitor structural characteristics of materials to be used in levee construction.
- o Control potential entry of floodwaters through siphons, pipes, and gates on drainage and water supply facilities.

Impact: Effects of Project on Adjacent Levees

Development of the Brookside site would have little lasting impact upon the bordering channels beyond that which has already been caused by levee construction. However, construction activities to increase elevations of the levees to meet flood protection requirements would cause some short-term disturbance to adjacent areas and plant and animal habitats.

Thick concentrations of organic matter in project site soils require long lead times for settling before levee construction. Soil settling in the southwestern corner of the site could range from 2 to 3 feet. Typically, 90 percent of settlement occurs within the first 3-4 months of loading, and 95 percent within 1 year. Design heights of levees contain additional freeboard to account for settlement, and monitoring programs are conducted after construction to measure settlement (Yost pers. comm.).

Efforts are being made to raise the crown elevations of the project site levees to control the flood hazard. An additional height of 2-3 feet is required on the Fourteen Mile levee to bring it to the required 11.1 feet. The Ten Mile levee design elevation is 15.8 feet, which provides protection against wind-generated waves (R. C. Fuller Associates 1983).

The project proponents are not proposing to dredge channels to build up levees. Levee heights would be increased with onsite fill from the proposed lake. The COE does not require a permit if nondredged material is placed on the landward side of a levee. If material is added to the levee's water side, a COE 404 permit would be required.

In accordance with the City of Stockton's Flood Damage Protection Ordinance, the removal of this property from the floodplain must be approved by FEMA prior to development. This designation requires the developer to obtain all necessary state and federal permits, including the satisfaction of FEMA requirements. The City of Stockton recently adopted Ordinance No. 086-87, dealing with flood damage protection. This ordinance is based on FEMA's newly established flood protection requirements.

The effect of the proposed project on adjacent levees is considered less than significant. To further reduce this impact, the following recommendations should be considered.

Mitigation Measures

- o Place material only on the tops and landward sides of levees to avoid damage to wetland habitat and to prevent entry of sediments into adjacent channels.

- o Monitor structural characteristics of material to be used in levee construction.

- o Preload levee construction sites or conduct construction in stages to allow compaction and settlement of basal material. This is especially important in the southwestern corner of the site where thick peat deposits are located.

- o Observe the requirements of FEMA and the COE.

- o Investigate and control other potential sources of entry of floodwaters, such as siphons, pipes, and gates on drainage and water supply facilities located on the perimeter of the property.

- o Ensure that settlement does not reduce elevations of levees below safe levels; this requirement is based on the need to monitor levee heights following construction to assess the extent of settlement.

Impacts: Alteration of Internal Drainage Characteristics

Covering 824 acres of soil with impervious pavement and structures would greatly increase runoff coefficients and peak runoff volumes for the developed area. The runoff would be stored onsite and/or pumped into one or more of the surrounding channels. A master storm drainage plan would be prepared for the project early in the design phase to accommodate the need for a restrained runoff. Until the project applicant's engineer prepares calculations of runoff volumes or a detailed drainage management plan, changes in internal drainage plans can only be described in general terms.

All drainage facilities would be designed and constructed to standards of the City of Stockton and dedicated to the City after construction. Following construction, the City would own the drainage system and R. D. 2074 would own and maintain only its portion of the levee system (Yost pers. comm.).

More than 247 acres of the site would be used for a golf course and 47 acres for a lake. Both the golf course and the lake could have beneficial impacts on the runoff and groundwater changes brought by urbanization of the remainder of the site. The lake would be used as storage for runoff from development north of March Lane, and the lake right-of-way would be conveyed to the City of Stockton as a stormwater drainage easement. The lake could reduce stormwater discharge from a 10-year storm from approximately 160 cfs to 10 cfs over 4 to 5 days. Topography may dictate that a small portion of the area north of March Lane be drained directly to Fourteen Mile Slough rather than to the lake (Yost pers. comm.).

The golf course would serve a similar function for the area south of March Lane. A proposal to have an interconnected system of ponds related to the drainage system is being reviewed. Discharge from the golf course area may be divided into drainages north and south of the EBMUD right-of-way. Approximately 70 cfs of stormflow would be generated by a

10-year storm in the areas north of the EBMUD right-of-way, and 100 cfs to the south (Yost pers. comm.). The golf course would also provide a substantial area of permeable surface with low runoff coefficients, in which groundwater recharge could occur. Because the elevation of the golf course is planned to be lower than that of the lake, its surplus water would not be pumped into the lake. The drainage-retention components of the Brookside design reduce the impact of the project runoff on adjacent rivers to a less-than-significant level.

Numbers and locations of pump stations and main drains have not yet been determined. The existing pump station at Fourteen Mile Slough would remain, but would require an increase of pump capacity to handle project runoff. This pumping station could be complemented by pumps at Ten Mile Slough north of Buckley Cove and one or more pumps along the Calaveras River.

The lake is planned to be 6-8 feet deep in the center, with steep-sided shore slopes to impede growth of aquatic plants. The lake surface would be fairly close to the existing groundwater level, so that maintaining the lake at its design level should require a minimum of draining or filling. Although the lake bottom probably would be characterized by dense clays of limited permeability, the presence of the lake would help to stabilize nearby groundwater levels. Little measurable effect of the lake on groundwater levels is expected in the area (Yost pers. comm.). Therefore, the impact of the lake is considered to be less than significant.

Mitigation Measures

- The increased surface runoff caused by urbanization of the site would be largely mitigated by construction of the lake and golf course. These facilities would permit stormwater to be stored onsite and facilitate groundwater recharge. Storm discharge could be removed more slowly and with smaller pumps than would be required without onsite storage. Until the storm drainage master plan is completed, a detailed assessment of the impact of the project and suitable mitigations cannot be precisely stated.

Impact: Increased Demand for Regional Surface Water Supplies.

All of the domestic water requirements of the proposed project would be supplied by Stockton East Water District (SEWD) and the City of Stockton through conjunctive use of pumped groundwater and treated surface water. Over the next 32 years, the surface component of (SEWD) supplies is forecast to more than double, from 25,000 to 55,000 acre-feet (af) per year (Steffani pers. comm., Brown and Caldwell 1985) (Table D-1). Because water flowing through the Sacramento Delta is oversubscribed (Argent 1988), any increase in use of central California water would have a significant impact on regional or state supplies. Supplying the needs of the new residents would require a significant amount of SEWD water: two 16-inch water mains would be used to supply water to the project site. This impact is considered significant and cannot be reduced to less-than-significant levels. To partially reduce this impact, implement the following measures.

Table D-1. Change in Water Demand by Source for Stockton East Water District Service Area (in acre-feet per year)

Use	1980			2020		
	Surface	Ground	Total	Surface	Ground	Total
Municipal/industrial	25,000	30,000	55,000	55,000	40,000	95,000
Agricultural	30,000	170,000	200,000	60,000	114,000	174,000
Total	55,000	200,000	255,000	115,000	154,000	269,000

Sources: Steffani pers. comm., Brown and Caldwell 1985.

Mitigation Measures

- o Make water conservation an important goal in the design and operation of the project, as described in the "Water Supply" section of this report. Although many of the water conservation actions needed to reduce demand in the Stockton area should be undertaken by the City and county, much could be accomplished by designers of individual developments. The water use impact of the proposed project could be partially mitigated by taking the following actions:

  - using drought-tolerant vegetation in landscaping,
  - minimizing the use of lawns and other water-consuming landscape elements,
  - planting drought-tolerant street trees on each residential lot in the development,
  - using water-conserving bathroom fixtures that meet or exceed those required by California law,
  - designing and landscaping model homes to display water conservation,
  - providing educational materials on water conservation to project residents, and
  - designing the golf course to maximize the efficiency of sprinklers and minimize water needs.

Cumulative Impacts and Mitigation Measures

Impact: Increased Demand on Regional Drainage Capabilities

In moderate storm conditions, the cumulative effect of the proposed project and related projects would have no significant impact on surface water levels. The Brookside project would not, however, contribute substantially to the cumulative effects because the lake and golf course on the project site would mitigate the effects of pumping on flood elevations of surrounding rivers.

During severe storm conditions, the cumulative effects of planned developments in the Stockton area could prove significant. Should the lake and golf course be at maximum storage, the project pumps would function as if no onsite storage were available and operate at full capacity to deliver water to the rivers. If other Stockton developments were to pump while the rivers were at bank-full stage, then the potential for flooding would be increased by additional development. The flood hazard potential is influenced more severely by upstream developments than by the proposed project, because the Brookside property is at the downstream portion of the Stockton development area. This cumulative impact is considered potentially significant.

Mitigation Measures

- o The City should continue to review regional flood management programs by FEMA and San Joaquin County Flood Control and Water Conservation District, and on the basis of these investigations

develop strategies to control cumulative flooding impacts such as levee improvements and onsite retention basins. See also the "Public Services and Utilities" section of this report.

Impact: Increased Demand for Surface Water

The cumulative effect of the proposed project and other developments on surface water supplies for domestic use would be significant. The extent of the impact would be determined by the proportion of surface water used in the City of Stockton's conjunctive use system. This impact could affect the amount of surface water in regional streams available to sustain biological resources and to supply agricultural and other water users in the region and the state.

Mitigation Measures

None available. Water conservation programs can reduce this impact but not to less-than-significant levels.

WATER QUALITY

Setting - Surface Water

Surface water supplies for the irrigation of project site agricultural operations come from the San Joaquin River. The project proponent holds riparian rights on the San Joaquin and Calaveras Rivers and Fourteen Mile Slough. Water quality data on these three water bodies are sparse. Long-term water quality monitoring records exist only for the San Joaquin River, where the California Department of Water Resources (DWR) collects samples near Buckley Cove.

Table D-2 presents selected water quality information from DWR Buckley Cove monitoring. Data are presented for spring and fall months for 7 years from 1978 to 1985 (1984 records were missing). The measures of turbidity, total dissolved solids (TDS), all deal with clarity and amount of material suspended in river samples. Chlorides and electrical conductivity (EC) indicate the concentration of salts in the water. Dissolved oxygen (DO) and temperature are related to the ability of the water to sustain fish and other organisms.

Relatively little seasonal variation occurs in most of the values. Water clarity, salinity, and pH vary little between spring and fall. Mean temperature is significantly higher in September than in March, as would be expected. DO declines substantially in fall, probably reflecting a higher rate of decomposition of organic matter in the warmer water, as well as less oxygenation during low flow periods.

Table D-2. Water Quality: San Joaquin River at Buckley Cove

Indicator	March								September							
	1978	1979	1980	1981	1982	1983	1985	Mean	1978	1979	1980	1981	1982	1983	1985	Mean
Secchi disk (cm)	32	32	32	80	56	26	80	48	44	34	46	62	47	52	56	48
Total dissolved solids (mg/l)	205	277	126	442	n/d	145	364	260	304	285	319	246	221	103	321	257
Turbidity (NTUs)	29	23	22	7	12	27	6	18	11	17	10	10	16	10	11	12
Temperature(°C)	15	13	14	14	11	13	13	13	23	25	25	25	23	20	21	23
Chlorides (mg/l)	33	60	20	97	n/d	20	78	51	84	82	85	60	45	17	71	63
Electrical conductivity (microsiemens/cm @ 25 °C)	349	242	210	779	299	265	488	376	503	519	647	437	392	177	561	462
Dissolved oxygen (mg/l)	8.6	9.4	9.5	6.9	9.0	9.1	8.3	8.7	5.6	5.8	6.3	5.9	7.0	7.7	6.0	6.3
pH	7.6	7.7	7.2	7.5	7.1	7.2	7.4	7.4	7.6	7.2	7.5	7.4	7.2	7.0	7.3	7.3

n/d = no data.

Source: Department of Water Quality Annual Reports, 1978-1985.

Overall, these data indicate that the San Joaquin is a fairly healthy stream. Its waters are not very clear, although the mean TDS values exceed the Class I standards for irrigation water quality established by the U. S. Department of Public Health. San Joaquin River TDS values are less than 300 milligrams per liter (mg/l), or less than half of the Public Health standards of 700. San Joaquin water also exceeds these standards for chlorides (56 parts per million [ppm] versus 175 ppm), and the standards established by the California State Water Resources Control Board (SWRCB) (1975) for Delta waters.

Project Impacts and Mitigation Measures - Surface Water

Impact: Effects of Domestic Consumption on Local Surface Water Resources

Water use requirements of the proposed project would have little impact on the quality of water in adjacent rivers and sloughs. Future residents of the project site would receive their domestic water from the City of Stockton system. This source of supply, combined with the curtailment of agricultural irrigation, probably would cause a net decline in the amount of water withdrawn from surrounding streams. Some continuing use of riparian water would be required for the golf course and to maintain lake water levels during summer.

Increasing the demand for SEWD/City of Stockton water would increase competition for surface water elsewhere in the region. Hence, the switch from riparian water for irrigation to SEWD water for domestic consumption would constitute a change in the location of impact rather than a mitigation of the impact on groundwater supplies. Nonetheless, the use of SEWD water for domestic consumption and riparian water for golf course irrigation and lake topping-up would have a less-than-significant impact on quality of surface water in the vicinity of the project site.

Mitigation Measures

o None required.

Impact: Degradation of Surface Water Quality by Runoff

Water quality in the San Joaquin River may be affected by the discharge of urban runoff from the project site. The river would receive runoff from the entire site, some of which would have been stored in the proposed artificial lake. Residual oils from roads and parking lots, lawn care chemicals, other materials that are poured or carried into storm drains, and fertilizers and biocides from the golf course would eventually reach the runoff disposal system and the river. The unknown concentrations of these materials in runoff from the development create a potentially significant impact in the vicinity of the storm outfall in Buckley Cove and the San Joaquin River.

Golf course runoff could introduce undesirable nutrients and biocides to surrounding waters. Because runoff from the golf course would be pumped

directly to adjacent rivers rather than to the lake, little opportunity exists to buffer the effects of the runoff. Care should be exercised in managing the golf course to minimize use of chemicals and fertilizers that would be undesirable in adjacent rivers. If California Department of Food and Agriculture (DFA) regulations and guidelines for use of biocides are rigorously followed, water quality impacts of the golf course could be minimized (Ford pers. comm.). DFA regulation 11000 501 (A) limits the ability of local councils to control the use of pesticides, so the DFA must be relied upon to monitor pesticide use and enforce regulations. The Pesticide Applicators Professional Association can assist and advise golf course managers in the proper use of biocides (Ford pers. comm.). This impact could be reduced to a less-than-significant level by implementing the following measures.

Mitigation Measures

The impacts of domestically used chemicals on water quality can be mitigated by the following actions:

- The City should require automobile service stations to provide collection facilities for motor oil and hydrocarbon fuels;

- The City should require sellers of fertilizers, biocides, and related lawn and garden chemicals to provide for the collection and disposal of unwanted materials from residents;

- The homeowners association or City should provide educational materials to residents on the use and disposal of fertilizers, pesticides, herbicides, motor oil, gasoline, and other persistent or potentially harmful chemicals;

- The City should monitor the water and sediments in the artificial lake annually to assess the concentration of harmful chemicals and to determine whether additional action should be taken.

- A lake management plan should be prepared for the artificial lake. The plan would outline water quality monitoring schedules and establish responses so that high quality water can be maintained in the lake and the Delta. Groups and regulatory agencies concerned with preparation of the lake management plan should be involved.

In the operation of the golf course, many of the impacts on water quality can be mitigated by controlling the use of biocides and fertilizers.

- Rapid-release fertilizers can generate more chemicals than can be used by vegetation, while slow-release fertilizers are less likely to cause this problem. Slow-release fertilizers are therefore less likely to pollute ground and surface waters.

- Biocides that persist in the environment should be avoided. Pesticides and herbicides should be used only as part of a carefully formulated plan of integrated pest management or

vegetation manipulation. Such a plan should be prepared both with the advice of experts in integrated pest management and the Pesticide Applicators Professional Association.

- Irrigation should be limited after application of fertilizers and biocides to prevent leaching of chemicals into groundwater or transport in runoff to surface water bodies. Application of fertilizers and biocides before the onset of the rainy season should be avoided to reduce the risk of leaching and surface transport of chemicals.

Impact: Creation of a New Lake

The creation of a new body of surface water would be a significant impact of the proposed project. The quality of water in the new lake would be an important concern because it would serve several functions: as an aesthetic amenity for neighboring residents who would be owners of the lake, a drainage facility for the City of Stockton, and habitat for fish and other organisms. Because excess runoff would be transferred from the lake to surrounding public surface waters, the RWQCB has an interest in the quality of discharge.

No long-term monitoring or even spot testing of water quality or sediments of other artificial lakes in the Stockton area have been conducted. Therefore, both the description of present lake performance and prediction of future impacts are based on opinions, experience with other lakes, and hydrologic concepts.

Ownership of the Lake. Control of the lake would devolve over time from the project proponents to the land owners. Upon completion of the lake, a lake association comprising owners of the land surrounding the lake would be formed. For the first few years after completion of the lake, most of the lake association membership would come from the project proponents (Addington pers. comm.). As lots are sold, an increasing proportion of the membership would come from lakefront property owners. The lake association would be responsible for maintaining the depth and water level of the lake, banks of the lake, and lake water quality and aesthetics. Waterfront owners would be responsible for control of erosion and subsidence.

Controlling Growth of Aquatic Vegetation. Controlling the growth of aquatic plants and algae would be a major concern of the lake association and the RWQCB. In earlier years, copper-based herbicides were commonly used to control algae in artificial lakes, but its accumulation in bottom sediments, deleterious effects upon other aquatic organisms, persistence in the environment, and transport into other water bodies has led to concern over its use. Recent investigations have disclosed that clear lake water encourages the growth of aquatic plants. Decay of these plants reduces water oxygen levels and contributes to the growth of pond scum.

Design of Lake Bottom Configuration. The configuration of the lake bottom can affect the extent of growth of aquatic plants. Plants grow best in shallow areas where sunlight penetrates to the lake bottom. In some

artificial lakes in the Stockton area, a gradual bottom slope around the shore has fostered plant growth. The proposed lake is to feature a steeper shoreline configuration, which should reduce the area most favorable for plant growth.

Management of Aquatic Vegetation. A shift in emphasis in lake management from chemical control of weeds and algae to a more ecologically based approach has proven effective in other artificial lakes in the Central Valley. By encouraging growth of plankton in the lake, turbidity can be increased, thus diffusing light penetration and interfering with plant growth. If the nutrient status of the lake requires enrichment to encourage plankton, phosphorus fertilizer can be applied. The plankton gives the water a greenish tinge that some residents find objectionable. This problem can be corrected by adding a blue dye to the water. The dye also increases turbidity, further limiting plant growth. The effectiveness of these actions is increased through understanding of the timing of plant germination and by using sonar devices to pinpoint plant concentrations on the lake bottom. If plants become established before turbidity can be increased, then spot treatment with weed cutters or contact herbicides such as Diquot can be effective (Ayers pers. comm.).

This ecological approach to lake management has several advantages. The reduced use of herbicides yields a higher quality water, is less hazardous to fish and other organisms, and the effects of transport of toxic materials are reduced. Of interest to the lake association is that the cost per acre of turbidity enhancement may be as little as one-eighth the cost of chemically based plant and algal control. Fertilizers reaching the lake from adjacent lawns can actually benefit plankton growth, and so are a benefit rather than a liability (Ayers pers. comm.).

Mitigation Measures

- If properly managed, the proposed lake could have a beneficial impact on quality of surrounding waters. As a storage basin for storm runoff, sediments may have a chance to settle, and oils may be trapped before being transported to surrounding rivers and sloughs. However, heavy metals from runoff may be deposited in lake sediments, and could be easily resuspended in the waters of the shallow lake.

- If the turbidity enhancement approach to control of aquatic plants is adopted, then nutrients in runoff and lake water may be used by lake plankton rather than being transported directly to surrounding waters, where such nutrients become pollutants. Care should be exercised to avoid over-application of clear river water to the lake during the warm summer months. Such actions could reduce lake turbidity and foster the growth of undesirable aquatic plants and algae.

- Potential damage to water quality in the lake would be mitigated if the developer and the lake association would educate residents as to the purpose of the lake and the importance of maintaining water quality. Such a program should include materials on the use and disposal of fertilizers, biocides, and hydrocarbon fuels.

Cumulative Impacts and Mitigation Measures

Impact: Effects on Regional Surface Water Resources

The conversion of agricultural land to urban uses in all of the developments slated for Stockton could reduce the amount of riparian water withdrawn from adjacent streams. Hence, there could be a locally beneficial cumulative impact on the supply of water in Stockton's rivers.

The switch from agricultural to urban land uses would be accompanied by a 73 percent increase in demand for domestic water (Table D-1). This increased demand would be felt regionally as increased volumes of New Hogan and New Melones surface water are withdrawn and the competition among users for surface water increases. Additional demand for surface water can be perceived as a transfer of impacts from groundwater to surface water, rather than as mitigation of the impact altogether. This significant impact cannot be mitigated to a less-than-significant level. To partially reduce this impact the following measure should be implemented.

Mitigation Measures

- The scale of cumulative increase in demand for domestic water is so large that even stringent conservation measures would not reduce the impact to less than significant. Conservation practices, however, would reduce the severity of the impact. No mitigation measures are available to reduce impacts to a less-than-significant level.

Impact: Creation of a Lake

The impact of constructing a lake on the project site would not affect other slated developments in Stockton. Even if such developments involved lake construction, the effects would be localized. Therefore, the cumulative impacts of lake construction are less than significant.

Mitigation Measures

- None required.

Setting - Groundwater

The San Joaquin basin is the largest groundwater basin in California. It covers 13,500 sq mi and overlies an aquifer roughly 1,000 feet deep. Despite its huge usable capacity of 80 million af, excessive overdraft has led to poor water quality problems in the Delta and a subsidence level of as much as 28 feet near Mendota (Department of Water Resources 1975). This

overdraft exists because approximately one-quarter of all the groundwater pumping in the U. S. occurs in the Central Valley. The eastern San Joaquin Basin, which includes the project site, has been characterized as "subject to critical conditions of overdraft," meaning that continuing present use patterns could cause serious adverse environmental, social, or economic impacts (Department of Water Resources 1980).

Saltwater Intrusion

Groundwater quality is a serious problem on the project site. This problem results from saltwater intrusion caused by excessive overdraft in the San Joaquin Basin. Groundwater has been monitored very little on the project site. However, the SEWD tested one well in the project site at the request of the owner and discovered chlorides at the remarkable concentration of 2,800 ppm (Steffani pers. comm.), or more than 10 times the suggested limits of 250 ppm for drinking water. However, at a well just east of the Brookside property, 17 years of records revealed uniform chloride concentrations of 50 ppm (San Joaquin County Flood Control and Water Quality District 1987). Because the project site is not served by SEWD or City of Stockton water, residents of the site probably rely partly on well water for domestic use. They may use shallow wells that tap groundwater of a quality similar to that in surrounding surface waters.

In addition to salinity problems, San Joaquin Valley groundwater also is subject to contamination by pesticides. In 1979, half of the 120 wells sampled in the eastern San Joaquin Valley (which includes the project site) contained DBCP (1,2-Dibromo - 3 chloropropane). Pesticide contamination is believed to be caused by migration of persistent chemicals from agricultural operations into groundwater. In California, 92 percent of all pesticides are used for agriculture, which is the most important and widespread economic activity in the Central Valley (Litwin 1979). By 1981, 16 chemicals had been identified in San Joaquin County groundwater. The most common pesticides were altrazine (simazine), chlorinated hydrocarbons (such as DDT), diazinon, phorate, and unknown organophosphates (such as parathion) (Department of Water Resources 1981).

Groundwater Recharge

The poor quality of groundwater on the project site precludes its use for irrigation or drinking. The reliance of the proposed project on City water for domestic consumption would worsen overdraft problems of the San Joaquin region because increased pumping from existing or new wells would be required (Montgomery pers. comm.). More than 3,500 new dwelling units would replace the existing scattering of homes on the project site. Despite the presence of the lake and golf course, the project would result in a net increase in groundwater withdrawal over current conditions. This impact on groundwater overdraft is significant.

The severity of this overdraft impact would be reduced somewhat by the proponent's proposed use of riparian water for irrigation and lake level maintenance. Net recharge of groundwater should occur on the lake, park, and the golf course, which have a combined area of about 300 acres.

Although the benefit of this recharge would not be substantial and would be measurable only locally, it nonetheless would be a reversal of the prevalent direction of transport of groundwater in the basin.

Cessation of Agricultural Use

The cessation of agriculture on the project site could lead to a net reduction in application of pesticides and herbicides on the land. Although homeowners and golf course managers are often prone to over-application of biocides, the absolute amount used would probably be less than the amounts applied to crops now grown. This reduction should mean that fewer persistent chemicals would percolate into groundwater or be pumped into surrounding waters.

Project Impacts and Mitigation Measures - Groundwater

Impact: Effects of Project on Groundwater Quality

The net local impacts of the project on groundwater would probably be positive. The cessation of agriculture and attendant application of biocides and fertilizers would improve the quality of groundwater in the vicinity of the project site. This benefit would be offset somewhat by the application of chemicals to the golf course and residential properties. Groundwater would be slightly recharged by the operation of the lake. This impact is considered less than significant.

The net regional effect of the proposed project on groundwater quality would be negative. Pumping of groundwater as part of conjunctive use by the City of Stockton would further deplete groundwater sources in the region, increase overdraft of the aquifer, and cause a further advance of the saline front. This impact is considered a significant adverse impact. The following measures would be required to mitigate this impact to a less-than-significant level.

Mitigation Measures

- Minimize groundwater usage through increased, long-term use of domestic surface water sources, and riparian sources for project irrigation. Table D-1 indicates that by increasing surface water supplies, groundwater usage could decline by 2020.

- The quality of groundwater is directly related to the amount pumped. Therefore, conservation of water for domestic use would benefit groundwater quality in the basin. Recommendations for groundwater conservation in the "Hydrology" and "Public Services and Utilities" sections of this report would also mitigate impacts on groundwater quality.

- The golf course should be managed with concern for the quality of groundwater. The types of chemicals and fertilizers applied on the golf course and the timing of application should be planned to

reduce possible deleterious impacts on groundwater. See mitigations in the "Water Quality" section of this report.

Cumulative Impacts and Mitigation Measures

Impact: Groundwater Quality

The severity of saltwater intrusion into the aquifer beneath Stockton is controlled by the extent of overdraft of groundwater in the region. Hence, the cumulative impacts of the slated Stockton developments on saline intrusion would be a significant adverse impact that could only be reduced to a less-than-significant level by implementing the following measures. The extent of groundwater pumping will be affected by the proportions of ground and surface water available in the SEWDs conjunctive use program.

Mitigation Measures

- Refer to mitigation measures identified above, "Effects of Project on Groundwater Quality."

- Conservation measures identified in the "Surface Water" subsection above and "Public Services and Utilities" section of this report could partially mitigate the severity of the cumulative impacts of groundwater pumping and saltwater intrusion, but the impacts are likely to remain significant.

C-065271